

Switching device

The invention relates to a switching device according to the preamble of claim 1.

Switching devices with magnetic tripping arrangements are known. Such magnetic tripping arrangements are usually used for disconnecting switching contacts in the case of an occurring short circuit. The magnetic tripping arrangement usually comprises a current-carrying coil which is enclosed by a yoke. A movable armature is arranged in the interior of the coil which is accelerated by the magnetic field of the current-carrying coil against an armature spring and causes the disconnection of a movable electric contact from a fixed electric contact during the occurrence of a short circuit. In order to focus the magnetic field lines towards the armature, it is known to arrange a yoke sleeve on the yoke which faces towards the armature, which yoke sleeve is arranged as a turned part by means of metal cutting.

It is the object of the invention to provide a switching device of the kind mentioned above in which the production costs and input of power and raw materials for its production can be reduced.

This is achieved by the features of claim 1.

The laborious metal cutting of the yoke sleeve can thus be avoided. Time and production costs can thus be saved in the production of the yoke sleeve. No waste in the form of valuable metallic material is thus obtained during production of the yoke sleeve. Expenditure for the purchase of material can be lowered in addition to production costs by the lower input of metal. As a result, both the input of power for producing the yoke sleeve as well as the input of raw material will thus decrease. As a result, both the required energy as well as the limited raw materials are used in a responsible manner, and not wasted, thus reducing the burden on the environment.

The subclaims, which like claim 1 simultaneously form a part of the description, relate to further advantageous embodiments of the invention.

The invention is now explained in closer detail by reference to the enclosed drawings, in which merely preferred embodiments are shown by way of example, wherein:

Fig. 1 shows a magnetic tripping arrangement for a switching device in accordance with the invention in an axonometric view;

Fig. 2 shows the magnetic tripping arrangement according to Fig. 1 in a side view;

Fig. 3 shows the magnetic tripping arrangement according to Fig. 1 in vertical sectional view;

Fig. 4 shows the view according to Fig. 3 in a partly sectional view;

Fig. 5 shows the view according to Fig. 1 in an exploded view;

Fig. 6 shows a yoke sleeve according to the state of the art;

Fig. 7 shows a yoke sleeve in accordance with the invention, and

Fig. 8 shows a yoke sleeve according to Fig. 7 in an exploded view.

Figs. 1 to 5 show a magnetic tripping arrangement 1 for a switching device, with the magnetic tripping arrangement 1 comprising at least one armature 2, a coil 3, a yoke 4 and a yoke sleeve 5, with the armature 2 and the yoke sleeve 5 being arranged in a substantially aligned manner, with the coil 3 being arranged substantially around the armature 2 and/or the yoke sleeve 5, with the yoke 4 being arranged around the coil 3, and with the armature 2 being formed for the at least indirect tripping of a disconnecting apparatus of the switching device, with the yoke sleeve 5 being formed by at least one first bent part 6.

The laborious production by metal cutting of the yoke sleeve 5 can thus be avoided. As a result, time and production costs can be saved in the production of the yoke sleeve 5. No waste in the form of valuable metallic material is thus obtained during production of the yoke sleeve 5. Expenditure for the purchase of material can be lowered in addition to production costs by the lower input of metal. As a result, both the input of power for producing the yoke sleeve 5 as well as the input of raw material will thus decrease. As a result, both the required energy as well as the limited raw materials are used in a responsible manner, and not wasted, thus reducing the burden on the environment.

Switching devices in accordance with the invention are preferably arranged as miniature circuit breakers or automatic circuit breakers. Switching devices in accordance with the invention comprise at least two terminals 11, an input and output terminal, for the connection of electric conductors to an electric line to be protected. Switching devices with a single breaker gap as well as a predetermined number of electric breaker gaps can both be provided. Switching devices in accordance with the invention comprise at least one movable electric switching contact for each breaker gap which in combination with a further, preferably fixed, electric switching contact 13 forms a pair of switching contacts

for making or breaking the electric line to be protected. The at least one movable electric switching contact is preferably moved by a breaker mechanism. Preferably, substantially all components of a switching device in accordance with the invention are arranged within a housing made of insulating material which comprises breakthroughs at least for one manual actuating lever and for the terminals 11. Switching devices in accordance with the invention are usually arranged in current-carrying outer conductors or phases.

Switching devices in accordance with the invention comprise at least one magnetic tripping arrangement 1 which is provided for tripping the switching device, and therefore for disconnecting the electric switching contacts 13, in the case of a short circuit occurring in the electric line to be protected, therefore a low-impedance connection between an outer conductor or a phase and the neutral conductor. Furthermore, especially preferred embodiments of switching devices in accordance with the invention further comprise a thermal tripping arrangement which is preferably arranged to comprise a bimetallic element for tripping the switching device as a result of a slightly increased current flow.

The magnetic tripping arrangement comprises at least one armature 2, a coil 3, a yoke 4 and a yoke sleeve 5. The coil 3 forms within the switching device a part of the electric line to be protected. A first connection lead 10 of the coil 3 is connected with a terminal 11 of the switching device and a second connection lead 12 of the coil 3 is connected with a fixed switching contact 13 of the switching device. The coil 3 is preferably arranged about a winding support 14 which is made of insulating material and substantially has the shape of a cylinder, at the end of which a shoulder 18 is formed. Coil 3 is enclosed at least in sections by a yoke 4 which is preferably arranged as a bent or punched sheet metal part and preferably has the shape of a substantially rectangular box and is used for guiding the magnetic flux. According to the preferred embodiment as shown in Figs. 1 to 5, the second connection lead 12 of the coil 3 is connected with a contact support 15 which supports the fixed electric switching contact 13, with the contact support 15 preferably also being connected with the yoke 4.

An armature 2, which is movable especially along its longitudinal extension, is arranged within the winding support 14 and is guided by the winding support 14, with the armature 2 being pressed by an armature spring 9 in the direction towards an idle position which is preferably formed by the shoulder 18 of the winding support 14. The coil 3, and especially the number and arrangement of the coil windings, and the spring force of armature spring 9 are dimensioned in

such a way that the armature spring 9 presses the armature 2 against the idle position in short-circuit-free operation, but in the case of a short circuit accelerates the armature 2 in such a strong manner against the spring force of the armature spring through the electromotive force generated by the coil that its spring force is overcome and the armature 2 moves away from its idle position and causes a tripping of the switching device.

It is provided in the special embodiment of a magnetic tripping arrangement 1 as shown in Figs. 1 to 5 that the armature 2 does not directly trigger the switch, but that the armature 2 drives a tappet 8 which is made of an insulating material, and the armature 2 trips the switch indirectly via the tappet 8. For this purpose, yoke 4 further comprises at least one first breakthrough 19 which preferably faces the fixed electric switching contact 13 and through which the tappet 8 acts on a preferably provided breaker mechanism, thus causing the upward movement of the movable switching contact. In this preferred embodiment, the armature 2 is arranged as a hollow cylinder, with a stop 20 for the tappet 8 being formed on its side averted from the first breakthrough 19. The armature 2 is arranged as a bent part according to the illustrated preferred embodiment. In the case of a magnetic tripping arrangement according to the especially preferred embodiment as shown in Figs. 1 to 5, the yoke further comprises a second breakthrough 23 through which the winding support is guided.

A yoke sleeve 5 is arranged on the yoke 4 in a flush manner in relation to the armature 2 which is arranged within the coil 3 or the winding support 14 according to the preferred embodiment. The yoke sleeve 5 is used for guiding or leading the magnetic field lines of the magnetic field generated by the coil 3 towards the armature. It is therefore provided that the yoke 4, the armature 2 and/or the yoke sleeve 5 comprise a ferromagnetic material. Preferably, the yoke sleeve 5 is arranged in the region of the first breakthrough 19. It is especially preferably provided that the yoke sleeve 5 is arranged at least in sections in the first breakthrough 19 and is preferably pressed or riveted together with the first breakthrough 19. The yoke sleeve 5 comprises a lead-through opening 21 in order to enable a penetration of the same by the tappet 8. Fig. 6 shows the yoke sleeve 16 according to the known state of the art which is arranged as a turned part.

The arrangement of an especially preferred magnetic tripping arrangement 1 for switching devices in accordance with the invention is shown especially clearly in Figs. 1 to 5, with the inner structure being shown especially well in Fig. 5.

It is provided in accordance with the invention that the yoke sleeve 5 is formed by at least one first bent part 6. A bent part shall be understood in the widest sense as being a component formed from sheet metal by bending, buckling and/or rolling. According to the illustrated especially preferred embodiments of a yoke sleeve 5, the first bent part 6 is made of a substantially rectangular sheet which is bent or rolled into a substantially cylindrical body. A yoke sleeve 5 thus formed comprises an air gap 17 in its longitudinal direction which does not cause any noteworthy magnetic losses because this air gap 17 is arranged parallel to the magnetic field lines caused by the coil 3. The air gap 17 ensures reduction of the impairment of the magnetic tripping arrangement 1 by magnetic fields scattered inwardly from the outside, because the air gap 17 represents a considerable resistance for magnetic field lines which are not arranged parallel to the same.

Figs. 7 and 8 show an especially preferred embodiment of a yoke sleeve 5 in accordance with the invention which comprises a first bent part 6 and a second bent part 7, or is made from the same, with the first bent part 6 being arranged within the second bent part 7. A yoke sleeve 5 thus formed comprises a yoke shoulder 22 which represents an advantageous stop for the automated assembly of the magnetic tripping arrangement 1, thus simplifying the assembly of yoke 4 and yoke sleeve 5. The first bent part 6 is connected with the second bent part 7 preferably by means of press fit according to a preferred embodiment, so that additional measures securing the connection can be omitted and simple and cost-effective production is achieved. It can be provided alternatively that the first bent part 6 is connected in an interlocking manner with the second bent part 7. Such an interlocking connection can be achieved by a knurled outer surface of the first bent part in which a preferably knurled inner surface of the second bent part 7 will engage. The interlocking connection can also be achieved by a predeterminable plastic deformation of the already assembled first and second bent parts 6, 7. Such an interlocking connection will help to achieve an especially secure hold of the first bent part 6 in the second bent part 7.

CLAIMS:

1. A switching device with a magnetic tripping arrangement (1), with the magnetic tripping arrangement (1) comprising at least one armature (2), a coil (3), a yoke (4) and a yoke sleeve (5), with the armature (2) and the yoke sleeve (5) being arranged in a substantially aligned manner, with the coil (3) being arranged substantially around the armature (2) and/or the yoke sleeve (5), with the yoke (4) being arranged around the coil (3), and with the armature (2) being formed for the at least indirect tripping of a disconnecting apparatus of the switching device, characterized in that the yoke sleeve (5) is formed by at least one first bent part (6).
2. A switching device according to claim 1, characterized in that the yoke sleeve (5) comprises a first bent part (6) and a second bent part (7).
3. A switching device according to claim 2, characterized in that the first bent part (6) is arranged within the second bent part (7).
4. A switching device according to claim 2 or 3, characterized in that the first bent part (6) is connected with the second bent part (7) by means of press fit.
5. A switching device according to claim 2, 3 or 4, characterized in that the first bent part (6) is connected with the second bent part (7) in an interlocking manner.
6. A switching device according to one of the claims 2 to 5, characterized in that the first bent part (5) is arranged within the second bent part (7) by forming a yoke shoulder (22).
7. A switching device according to one of the claims 1 to 6, characterized in that the yoke sleeve (5) is arranged as a component which is separate from the yoke (4).

8. A switching device according to claim 7, characterized in that the yoke sleeve (5) is arranged in a first breakthrough (19) of the yoke.
9. A switching device according to one of the claims 1 to 8, characterized in that a tappet (8) is arranged within the yoke sleeve (5) which is impinged at least indirectly by an armature spring (9).
10. A switching device according to one of the claims 1 to 9, characterized in that the yoke (4), the armature (2) and/or the yoke sleeve (5) comprise a ferromagnetic material.
11. A switching device according to one of the claims 1 to 10, characterized in that a first connecting lead (10) of the coil (3) is connected with a terminal (11) of the switching device, and a second connecting lead (12) of the coil (3) is connected with a fixed electric switching contact (13) of the switching device.